

1	(a)	(i)	0.6 : 1 ; ;		Correct answer = 2 marks Ratio must be correct way round 1: 0.6 is not correct but can still allow mark for correct working if shown If answer incorrect ALLOW 1 mark for working e.g. 600 ÷ 1000 600 : 1000 = 1 mark
				2	
		(ii)	as SA:VOL ratio decreases rate of diffusion decreases OR as SA:VOL ratio increases rate of diffusion increases ; use of two pairs of figures with correct units (mms ⁻¹) for rate to illustrate trend ; ref to rate of diffusion in either of the first two cubes not fitting trend ;	max 2	ACCEPT positive correlation DO NOT CREDIT as rate of diffusion decreases SA:VOL ratio decreases use of figs requires ratio quote and rate quote at two points e.g. at SA:VOL of 3:1 rate is 0.02 mms ⁻¹ , at SA:VOL ratio of 0.2:1 rate is 0.013 (correct units only need to be used once) DO NOT CREDIT if unit for SA:Vol given ACCEPT correct calculation of rate change e.g. when the SA:VOL ratio was 3:1 the rate of diffusion was 0.020mms ⁻¹ which is 0.007mms ⁻¹ faster than the cube with 0.2:1 SA:VOL ratio
		(iii)	(large plants) have a, small / low, SA : VOL ratio ; idea of diffusion too slow (to supply requirements) ; idea of need transport system (for water / minerals / assimilates) ; idea of need (special) surface area for, gaseous exchange / uptake of minerals ;	max 2	DO NOT CREDIT smaller unless we know smaller than what ACCEPT e.g. larger plants have a smaller SA : Vol ratio must have idea of too slow ACCEPT diffusion takes too long DO NOT CREDIT transport of gases
	(b)	(i)	divided length of side by time taken ;	1	IGNORE divide mm by s (units alone too vague)
		(ii)	idea that student used whole length of side, rather than half length ;	1	ACCEPT needs to divide answer by 2 / distance has to be to centre of cube rather than whole length of side / assumed diffusion occurs (across whole cube) from one side
	(c)		squamous epithelium short(er) diffusion, distance / path ; large number of alveoli large(r) surface area ; good blood supply high / large / steep, concentration gradient OR removes oxygen (from lung surface) / brings carbon dioxide (to lung surface); good ventilation high / large / steep, concentration gradient OR supplies oxygen (to alveoli) / removes carbon dioxide (from alveoli) ;	4	ACCEPT reduced / shorter diffusion distance ACCEPT thin diffusion barrier IGNORE thin diffusion pathway ACCEPT increases surface area IGNORE SA : Vol ratio ACCEPT maintains / creates concentration gradient IGNORE ref diffusion gradient ACCEPT maintains / creates concentration gradient IGNORE ref diffusion gradient IGNORE ref to air
Total				12	

2	(a) (i)	goblet / mucus (secreting) cell ; ciliated (epithelium) ;	2	DO NOT ACCEPT 'goblet' DO NOT ACCEPT 'cilia cell' 'ciliate'
	(a) (ii)	(A / goblet cells) release mucus / AW ; (mucus) traps, dust / particles / named particle ; ciliated cell / B / cilia, wave / waft / move, mucus ; to, top of trachea / back of mouth / AW ;	3 max	ACCEPT release / creates / produces / secretes DO NOT ACCEPT excrete ACCEPT bacteria / microorganisms / pathogens IGNORE dirt / germs DO NOT ACCEPT 'combines with' ACCEPT 'hair like projections' DO NOT ACCEPT 'hairs' Idea of up and out of lungs
	(a) (iii)	to constrict the bronchus / AW ;	1	example of AW e.g. reduce diameter of bronchus DO NOT ACCEPT 'ref to increasing diameter' – (note: if 'increase and decrease diameter' is used do not allow mark as it is contradiction) ACCEPT 'airways' ACCEPT 'control flow of air'
	(b) (i)	short, distance / path / AW ; (so that) diffusion / concentration, gradient is, high / steep ; high rate of, (gas) exchange / diffusion ;	2 max	DO NOT ACCEPT ref to number of cells / cell thickness or short space DO NOT ACCEPT short gradient ACCEPT high rate of movement of named gas in correct direction ACCEPT 'rapid' / fast / quick ACCEPT ref to efficient, gas exchange / diffusion DO NOT ACCEPT gas exchange occurs more 'easily'
	(b) (ii)	recoil / expel air / prevent bursting ;	1	ACCEPT exhale more completely / force air out DO NOT ACCEPT 'exhale' (if used alone) DO NOT ACCEPT 'contract' DO NOT ACCEPT 'stretch' on its own DO NOT ACCEPT if response includes any ref to bronchus or smooth muscle
Total			9	

3	(a)	<p>A = bronchiole ; B = alveolus / alveoli ;</p>	<p>2</p>	<p>Mark the first answer for each letter. If the first answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 marks. DO NOT CREDIT bronchus ACCEPT phonetic spelling of alveolus and bronchiole e.g. aveoli</p>
	(b)	<p>1 large, surface area / SA :VOL ;</p> <p>2 (alveolar) wall / epithelium, one cell thick ;</p> <p>3 (made of) squamous, cells / epithelium ;</p> <p>4 ref to surfactant ;</p> <p>idea of: 5 (very) close to, capillaries / blood supply OR rich blood supply / many capillaries ;</p>	<p>2 max</p>	<p>Mark the first <u>two</u> suggestions only. Read as prose unless candidate has indicated two points by bullets or numbers – in this case mark the first comment in each bullet.</p> <p>ACCEPT large SA / VOL, (alveoli) are small and in large number DO NOT CREDIT large amounts of tiny alveoli</p> <p>ACCEPT thin wall / thin barrier DO NOT CREDIT ref to cell wall / lining IGNORE alveolus one cell thick</p> <p>ACCEPT correct description of squamous cells (e.g. thin flat cell layer) ACCEPT pavement epithelium IGNORE reference to moist DO NOT CREDIT endothelium</p> <p>IGNORE ref to elastic fibres</p>
	(c)	<p>1 (histamine), binds / attaches, to, receptor / glycoprotein ;</p> <p>idea of : 2 in / on, plasma / cell surface, membrane (of muscle cell) ;</p> <p>3 <u>complementary</u> (shape) ;</p> <p>4 triggers response / causes effect, inside cells ;</p>	<p>2 max</p>	<p>binds to complementary receptor = 2 marks ACCEPT glycolipids IGNORE binding site, ref antigens</p> <p>ACCEPT in / on, cell surface / cell membrane (of muscle cells) ACCEPT membrane bound receptors (on muscle cells)</p> <p>CREDIT correct examples of effects / details inside cells e.g. ref to opening sodium channels in cell surface membrane ref to second messenger ref to cyclic AMP ref to activation of enzymes / kinases ref to phosphorylation</p>
	(d)	<p>idea of : 1 more tissue fluid formed / increase in volume of tissue fluid ;</p> <p>2 increase pressure in tissue ;</p> <p>3 swelling / inflammation / oedema;</p> <p>4 (more) white blood cells pass into tissues ;</p> <p>5 larger molecules / (named) proteins , pass into tissue fluid ;</p>	<p>2 max</p>	<p>Mark the first <u>two</u> suggestions only. Read as prose unless candidate has indicated two points by bullets or numbers – in this case mark the first comment in each bullet.</p> <p>IGNORE refs to the capillaries becoming more leaky IGNORE more water passes out</p> <p>DO NOT CREDIT cells swell</p> <p>ACCEPT (more) white blood cells leave the capillary</p> <p>IGNORE ref to more, glucose / nutrients / gases, leave blood capillary IGNORE ref to increased rate of diffusion</p>
		<p>Total</p>	<p>8</p>	

4	(a)	(i)	<p>1 <i>idea of</i> not breathing through nose ;</p> <p>2 subject breathes , evenly / normally / regularly ;</p> <p>3 <i>idea of</i> (measure) height / amplitude , of waves (from trace) ;</p> <p>4 measure at least three waves and calculate mean ;</p> <p>5 detail of how spirometer works ;</p>	max 3	<p>1 e.g. subject wears nose clip / plug or holds nose</p> <p>2 IGNORE at rest</p> <p>3 ACCEPT (measure) difference between peak and trough ACCEPT annotated diagram / annotations on graph</p> <p>5 e.g. as breathe <u>in</u> lid goes <u>down</u> / as breathe <u>out</u> lid goes <u>up</u> e.g. movement of lid recorded , on trace / by data logger e.g. pen attached to lid moves up/down as breathe DO NOT CREDIT description of water level changing IGNORE ref to using mouthpiece, soda lime, oxygen</p>
	(a)	(ii)	<p>10 further waves drawn with similar heights ;</p> <p>trace falls ;</p>	2	<p>Look for 10 extra peaks and 10 extra troughs Note 'similar' means no wave drawn for vital capacity – all waves should be approximately same height</p>
	(a)	(iii)	<p>1 measure , volume of oxygen used / decrease in volume in chamber ;</p> <p>2 one detail of how to measure volume change ;</p> <p>3 measure time taken (to use this oxygen) ;</p> <p>4 divide (volume) by time taken ;</p>	3	<p>1 ACCEPT annotations on graph ACCEPT 'measure how much the trace has gone down' or 'measure decrease in trace'</p> <p>2 e.g. draw line along tips of , peaks / troughs e.g. find difference in height from one , peak / trough , to another</p> <p>3 ACCEPT (measure volume of oxygen used) in a given time</p> <p>4 ACCEPT unit stated to indicate rate has been calculated e.g. dm^3s^{-1} / $\text{dm}^3\text{min}^{-1}$</p> <p>NOTE 'draw line along tips of, peaks / troughs and calculate gradient of line' = 3 marks (mark points 1, 3 & 4)</p>
	(b)		<p>1 check health of volunteer ;</p> <p>2 oxygen used ;</p> <p>3 new / sterilised / disinfected , mouthpiece (for each volunteer);</p> <p>4 <i>idea of</i>: soda lime working ;</p> <p>5 sufficient oxygen in chamber ;</p> <p>6 water level not too high / water must not enter tubes ;</p> <p>7 ensure valves working correctly ;</p>	max 2	<p>Mark the first two factors.</p> <p>1 e.g. check medical history of volunteer ask about asthma / TB / pneumonia / flu / bronchitis / emphysema</p> <p>3 IGNORE clean mouthpiece</p> <p>4 CREDIT need to remove CO_2 / CO_2 accumulates</p> <p>5 IGNORE enough air in chamber</p> <p>6 IGNORE general ref to leaks</p>
Total				[10]	

5

<p>C1 thin / squamous, epithelium ; C2 thin endothelium (of capillary) ;</p> <p>F1 (provides) short diffusion distance / described ;</p> <p>F2 ref to surfactant (from epithelial cells) , reducing surface tension / preventing alveoli collapsing ;</p> <p>C3 blood / red blood cells / erythrocytes ;</p> <p>F3 transports (named) gas(es) , to / from , exchange surface / alveoli ;</p> <p>C4 diaphragm / intercostals , muscles ;</p> <p>F4 (maintains / creates) diffusion / concentration , gradient ;</p> <p>C5 ciliated epithelium / goblet cells / ciliated cells ; F5 <i>idea of:</i> protection from / removal of , dust / bacteria / pollen / spores ;</p> <p>C6 cartilage ; F6 hold airway open ;</p> <p>C7 smooth muscle ;</p>		<p>allow F marks even if C mark not quite accurate</p> <p>C1/C2 IGNORE ref to alveolus / alveolar wall / capillary wall , without ref to epithelium / endothelium</p> <p>F1 ACCEPT diffusion barrier , thin / one cell thick IGNORE refs to speed or rate of diffusion IGNORE ref to reduces diffusion distance alone – must be in context of short distance DO NOT CREDIT ref to thin , cell walls / membranes</p> <p>F2 IGNORE ref to moisture</p> <p>C3 IGNORE (named) blood vessel ACCEPT blood supply / supply of blood</p> <p>F3 IGNORE ref to lungs IGNORE description of gas exchange</p> <p>F4 This can be awarded in context of F3 or C4</p> <p>F5 ACCEPT trap , dust / bacteria / pollen / spores IGNORE dirt / germs</p>
<p>F7 constrict / control diameter of , airway / blood vessel ;</p> <p>C8 elastic , fibres / tissue ; F8 for recoil / aiding ventilation ;</p> <p>C9 macrophage / neutrophil ; F9 engulf / destroy pathogens or protect from infection ;</p>	<p>max 4</p>	<p>F7 ACCEPT narrows lumen</p> <p>C8 IGNORE elastin / elasticated F8 ACCEPT prevent alveoli bursting</p> <p>C9 IGNORE ref to white blood cell unqualified</p>
<p>QWC ;</p>	<p>1</p>	<p>Any three with correct spelling and a suitable context from: epithelium / epithelial , endothelium , cartilage , diffuse / diffusion , gradient , goblet , ciliated , concentration , squamous , macrophage , neutrophil , surfactant , muscle , erythrocyte</p>

continued

6 (a)	1. Water and blood flow in opposite directions; 2. Maintains concentration/diffusion gradient / equilibrium not reached / water always next to blood with a lower concentration of oxygen; 3. Along whole/length of gill/lamellae;	3	Accept: diagram if clearly annotated 2. Must have the idea of 'maintaining' or 'always' in reference to concentration/diffusion gradient 2. Accept: constant concentration/diffusion gradient 3. Accept: gill plate/gill filament
(b)	1. (Thicker lamellae so) greater/longer <u>diffusion</u> distance/pathway; 2. (Lamellae fuse so) reduced surface area;	2	1. Q Neutral: 'thicker' diffusion pathway 2. Accept: reduced SA:VOL
(c)(i)	Correct answer of 5.1 or 5.14(2857) (dm^3) = 2 marks;; One mark for incorrect answers that show 36 or 0.4 x 90 or 90 ÷ 7 ;	2	Allow 1 mark max for an answer of 5 if the correct answer of 5.1 or 5.14(2857) is not shown
(c)(ii)	1. Increased metabolism/respiration/enzyme activity; 2. Less oxygen (dissolved in water);	1 max	1. Accept: enzymes work more efficiently Neutral: references to increased kinetic energy (of water molecules)

7	(b)	Correct answer of 342.8-343 = 2 marks;; Credit incorrect answers that show the numerator as 144 (or 186-42) or denominator as 42 for 1 mark;	2	
	(c)	1. More air/oxygen enters / air/oxygen enters quickly/quicker; 2. (So) maintains/greater diffusion or concentration <u>gradient</u> ;	2	1. Accept: converse for carbon dioxide 1. Can be in any correct context eg insect, tracheoles, muscle 1. Neutral: air/oxygen enters
	(d)	Large(r) SA:VOL / short(er) <u>diffusion</u> distance (to tissues);	1	Accept: thin diffusion pathway
	(e)	6 / 6.6 / 6.7 / 7 / 7.5 / 8 = 2 marks;; Award 1 mark for incorrect answers that have divided 60 by any number;	2	Different answers given for different interpretations of the graph
	(f)	Less/no water lost / (more) water retained;	1	Accept: less dehydration / less evaporation Q Reject: less 'transpiration' Q Reject: less water lost by osmosis
	(g)	1. Greater <u>surface area</u> exposed to air; 2. Gases move/diffuse faster in air than through water; 3. Increases volume/amount of air;	1 max	Neutral: shorter diffusion distance 2. Q Neutral: 'harder to diffuse' 2. Accept gases diffuse directly, rather than through water